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Personal, educational, employment, and earnings data were collected from 45 matched pairs, each pair consisting of a Gaston Technical Institute graduate and a high school classmate who did not engage in post secondary education. The objective of the study was to estimate the functional relationship between 2 years of technical schooling and the incomes of the graduates. Initial interviews were held in the summer and fall of 1963 and a second interview was held in September 1964 to update the data. Regression analysis was used to control the sources of variance related to home and community environment, academic performance in high school, civilian and military experience, and investments in migration. Findings included: (1) The average total cost per technical graduate was $7,425, foregone income accounted for 70 percent of this amount. (2) Approximately one-third of this cost was paid from public funds. (3) Average adjusted first-year earnings were $555 higher for the technical graduates. (4) Average monetary returns increased $161 per year for the first 4 years after technical schooling. (5) An estimated value of technical graduates' additional leisure time was $446 annually, and (6) Constant annual return projections to age 65 indicated a 16.7 percent rate of return for technical graduates, while similar projections based on differential annual returns indicated a 20.1 percent rate of return. The appendix includes the regression formula and design. (EM)

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ECONOMICS RESEARCH REPORT

COSTS AND RETURNS FOR INVESTMENTS IN TECHNICAL SCHOOLING BY A GROUP OF NORTH CAROLINA HIGH SCHOOL GRADUATES

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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COSTS AND RETURNS FOR INVESTMENTS IN TECHNICAL SCHOOLING BY A GROUP OF NORTH CAROLINA HIGH SCHOOL GRADUATES

INTRODUCTION

Every high school graduate has to make a decision concerning post-secondary schooling. Before completing secondary schooling some high school students plan to enroll in a postsecondary school. Others postpone the decision until later or even change their minds at some point in time after graduation from high school. No matter when or how the choice is made, few decisions are more critical to an individual's welfare.

The costs of postsecondary schooling are considerable, both to the individual and to society. For some individuals, postsecondary schooling may be the largest investment they will ever make. However, many people may be unaware of the real magnitude of resources, both private and public, which are devoted to postsecondary schooling. Some persons even object to the treatment of schooling as an investment in human capital.[1]

The purpose of considering schooling as an investment in human capital is quite clear. Each year resources worth billions of dollars are expended on formal schooling. Such resources could be used to build highways, increase police protection, build and staff more hospitals, or produce thousands of other economic goods and services. But, to divert resources away from education to other uses could also result in less benefit per dollar expended and lower real income for society. That is why knowledge of the costs and benefits of schooling is important.

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[1]Harry Shaffer, "Investment in Human Capital: Comment," American Economic Review, Vol. 51, December 1961, pp. 1026-1034.

Since some of the benefits of schooling are nonmonetary, the role of schools in teaching people citizenship and how to function as members of an informed electorate is often stressed. However important such considerations are, they may not justify the current level of expenditures on postsecondary schooling, much of which is used to develop highly specialized technical skills. Another aspect of schooling is currently being emphasized. There is an increasing awareness that the productivity of persons who obtain schooling is affected. Such an awareness could hardly be avoided since people with greater amounts of schooling generally earn higher incomes -- strong evidence that schooling increases productivity.

Even though there is ample evidence to demonstrate that education has capital value, there is still little knowledge of the magnitude of capital value created by schooling. For example, how much greater, if any, is the capital value of education through formal schooling than the value of resources used to provide the schooling? High school graduates are often advised to continue their education but are not given specific information about the total private costs of higher education or the potential returns. Until recently, few people had even attempted to estimate private or total costs and returns on investments in education at any level. Consequently, even public decisions as to the number, kinds and support of institutions of higher learning have generally been made with little specific information about costs or returns to society.

Since 1950 several research studies have been conducted for the purpose of answering specific questions about the costs and returns of schooling.[1] Most such studies have been directed at specific levels of

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[1]Although incomplete, the following list includes some of the more prominent studies: Ernest Havemann and P. S. West, They Went to College, Harcourt, Brace and Co., New York, 1952; Dael Wolfle and J. G. Smith, "Occupational Value of Education for Superior High School Graduates," Journal of Higher Education, Vol. 27, 1956, pp. 201-213; H. S. Houthakker, "Education and Income," Review of Economics and Statistics, Vol. 41, 1959, pp. 24-28; H. P. Miller, "Annual and Lifetime Income in Relation to Education, 1929-1959," American Economic Review, Vol. 50, 1960, pp. 962-986; T. W. Schultz, "Capital Formation by Education," Journal of Political Economy, Vol. 68, 1960, pp. 571-583; W. L. Hansen, "Total and Private Rates of Return to Investments in Schooling," Journal of Political Economy, Vol. 71, 1963, pp. 128-140; Shane Hunt, "Income Determinants for College Graduates and the Return to Educational Investment,"

schooling (elementary, secondary, college) rather than specific types of schooling. In general the results have indicated that investments in schooling yield high total and private rates of return. Thus, the studies have provided some support for the common belief that education pays. However, many questions remain unanswered, particularly with regard to costs and returns of additional investments in schooling and variations in costs and returns among the different types of schooling.

The study described in this report was conducted to estimate costs and returns for investments in two years of postsecondary technical schooling by a group of North Carolina high school graduates. Costs and returns estimates were used to evaluate the investments in technical schooling in terms of total returns, total and private rates of return, and additions to the stock of human capital. To make such estimates it was necessary that the various types of costs and returns for investments in higher education be fully enumerated. Some costs and returns may not be measurable in dollar terms. Nevertheless, pecuniary costs and returns were estimated, using caution not to minimize the importance of nonmonetary considerations. It is hoped that this report will provide public officials, high school counselors, parents and students with a more complete awareness of the types of costs and returns associated with postsecondary schooling, and an appreciation for the very important concept of human capital. If the procedures for estimating costs and returns or the specific information reported in this study directly aid those who must make educational investment decisions, then the authors will be truly gratified.

MEASUREMENT PROBLEMS

There are three major difficulties in measuring the costs and returns of investments in schooling. Each is mentioned briefly and then discussed in greater detail under an appropriate subheading. First, there is a problem of identifying the part of an individual's money income that is

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[1](continued) Yale Economic Essays, Vol. 3, 1963, pp. 304-357; G. S. Becker, Human Capital; A Theoretical and Empirical Analysis, with Special Reference to Education, National Bureau of Economic Research, New York, 1964; and Roy L. Lassiter, Jr., "The Association of Income and Education for Males by Region, Race and Age," The Southern Economic Journal, Vol. 32, No. 1, Part 1, 1965, pp. 15-22.

the result of productive abilities created by schooling. Returns to schooling should not be confused with income that is earned as a result of other assets belonging to the individual. Not only must the income effects of schooling be distinguished from the income effects of physical capital, but from other forms of human capital as well.[1]

The second difficulty concerns the measurement of nonmonetary costs and returns. Some of the benefits of schooling represent direct consumption to the individual. Such nonpecuniary considerations are important and should not be ignored even though any estimates of the value of nonpecuniary costs or returns are necessarily crude.

Third, production and consumption by persons other than individuals who obtain additional schooling may be affected. External effects may result in pecuniary and nonpecuniary costs or returns. External costs and returns are extremely difficult to identify and measure. Consequently, the treatment of external effects in this study is limited to recognition of a few possible ways in which external effects may occur.

Physical Capital

Most of the studies which have been conducted to estimate the costs and returns of education have utilized census reports of education and income. Since the census data do not allow one to distinguish between labor earnings and property income, Renshaw has been skeptical of the estimated rates of return on investments in education.[2]

Two sources of bias may affect the estimates whenever property income is not excluded. First, people who obtain higher education tend to be from families with higher than average wealth. Thus, they are more likely than high school graduates to receive property gifts and inheritance. Consequently, they would possess some wealth advantage from which to obtain an income because of the economic status of parents, not as a result of greater productivity following education.

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[1] In addition to investments in education, there are four other types of investments in people which tend to affect their level of productivity and are recognized as human capital. These are: (1) health care, (2) on-the-job training, (3) market information, and (4) migration.

[2] E. F. Renshaw, "Estimating the Returns to Education," Review of Economics and Statistics, Vol. 42, 1960, pp. 318-324.

Second, even with no gifts or inheritance, property income can introduce a bias which favors the educated. Bridgman discussed the possibility that higher labor earnings by educated people may result in greater personal savings and investments in property which yield income in addition to the previous advantage of labor earnings alone.[1] Such income should not be considered as a return on investment in education unless education makes it possible for people to invest more wisely and obtain a higher return. In the present study it is assumed that the correlation between property income and education is primarily the result of greater investments in physical property by the educated rather than greater wisdom expressed in the choice among investment alternatives. Thus, income from investments in physical property is not counted as return on investment in technical schooling.

Other Human Capital

People who obtain higher education may have been high school graduates who would tend to be above average among high school classmates in terms of ability to earn income, even without postsecondary schooling. This tendency may exist because the educated have higher than average inherent ability or because they are beneficiaries of a greater quantity of other investments in human capital.

In his pioneering work on the concept of human capital, Walsh discussed level of ability as a factor influencing returns for education.[2] Since then, practically every writer on the subject has indicated his recognition of correlations between ability, education and income. The problem, however, is to estimate the income earned on the basis of abilities created by schooling and to avoid counting that which is earned with abilities which are either inherent or created by other investments in human capital.

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[1] D. S. Bridgman, "Problems in Estimating the Monetary Value of College Education," Higher Education in the U. S., (S. I. Harris, editor), Harvard University Press, Cambridge, 1960, pp. 180-184.

[2] J. F. Walsh, "Capital Concept Applied to Man," Quarterly Journal of Economics, Vol. 49, 1935, pp. 255-285.

In previous studies people have used various means to adjust income data for abilities which may not be the result of a particular increment of schooling. Wolfle and Smith studied the relationship between intelligence test scores and incomes of males for a given level of education.[1] They estimated that men with higher intelligence scores earned a few hundred dollars a year more than those with lower intelligence scores. Likewise, for a given level of intelligence, those who had graduated from college earned $1,000 to $2,000 more per year than those with no formal education beyond high school.

Intelligence test scores tend to measure only the cognitive abilities of individuals without providing an adequate representation of manipulative skills and of motivation. Hunt selected high school grades in preference to I. Q. scores as a more comprehensive measure of ability.[2] However, his choice may have been influenced by the fact that he used the same data as previously analyzed by Wolfle and Smith. He also used an index of participation in extra curricula activities as a measure of social ability, but found that it was not significantly associated with variations in level of income.

In this study several variables, which may represent ability differences not attributable to postsecondary schooling, were analyzed and the estimated income effects of postsecondary technical education were adjusted accordingly. A description of the variables considered and the rationale for treatment of each variable is presented in Appendix A.

Nonmonetary Effects

One criticism against studies of the economic value of human capital stems from the difficulties of accurately evaluating nonmonetary costs and returns. The difficulties of estimating real income values, especially nonmonetary returns, may be even more serious for evaluations of human

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[1] D. Wolfle and J. G. Smith, "The Occupational Value of Education for Superior High School Graduates," Journal of Higher Education, Vol. 27, 1956, pp. 201-213.

[2] S. J. Hunt, "Income Determinants for College Graduates and the Return to Educational Investment," Yale Economic Essays, Vol. 3, 1963, pp. 304-357.

capital than for physical capital. The nonmonetary costs of investing in schooling may be negligible. The few writers who have discussed nonmonetary costs of schooling seem to be short of examples. Renshaw mentioned the disutility of studying, costs of moving to more distant jobs, and family estrangements.[1] To accept these as factors which should be counted requires some strong assumptions.

Since foregone earnings are normally counted as part of the cost of investing in schooling, studying represents an uncounted cost only if the disutility of schooling is greater than the disutility associated with the work that would have been performed in the foregone employment opportunity. If the disutility of studying is less than the disutility of employment, then real costs will be overestimated. In this study the two activities are treated as if equal insofar as satisfaction or disutility are concerned.

Migration to a job may normally be considered as a separate investment decision that results in a different form of human capital. Such investments and the corresponding returns should be excluded when evaluating investments in schooling. Investments in migration can be observed and quantified but costs and returns for other investments in human capital are often difficult to distinguish from investments in education. Some persons invest in on-the-job training by taking a job which pays less than alternative employment for the duration of the training period. Naturally they expect higher pay after training. But, on-the-job training is often informal and the costs are usually indirect. Thus, costs and returns for investments in on-the-job training could not be distinguished from costs and returns for technical schooling.

Although it is very hard to find empirical support for nonmonetary costs, there is more general agreement that nonmonetary returns to investments in schooling may be very important. For example, fringe benefits associated with occupations of people with higher education may be quite large. People with higher education may experience consumption gains as a result of greater awareness of social opportunities and also personal satisfactions from having knowledge that is common to only a small fraction of the population.

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[1] Renshaw, op. cit.

External Effects

One cannot escape the interdependencies which exist in a modern society. Investments in education, like investments in physical capital, may cause gains or losses for other members of society relative to conditions that might have existed if the resources had been used differently. However, it is entirely possible that the external benefits created by investments in human capital are of greater value than those normally associated with equal investments in physical capital. More informal education in the home for the offspring of better educated persons and a better informed electorate are examples of ways in which education may improve the welfare of other members of society. Placing a value on the net gain or loss from the host of possible specific effects would be a difficult, if not impossible, task.

The primary effort of this study was directed toward finding solutions to problems which might prevent reliable estimates of the direct monetary costs and returns for investments in technical schooling. Little attempt was made to do more than recognize nonmonetary and external costs and returns. However, the emphasis on estimating direct monetary costs and benefits of technical schooling should not be allowed to reduce awareness of unmeasured effects or to imply that the unmeasured effects are not important.

STUDY PROCEDURE

The monetary gain received by those who invest in schooling is the increased income they enjoy above that which would have been earned without the schooling. Unfortunately, there is no way to observe directly how much income a person with schooling would earn without the schooling. Estimates of the income gain are normally made by comparing the earnings of people with schooling to those of people who have not had the schooling. In such a comparison, allowances have to be made for the fact that people with different levels of schooling may also differ in many other characteristics which affect incomes.

Income data for this study came from two groups of people. One group had two years of post-high school technical education. The other group had not taken formal schooling or occupational training after graduation from high school.

The collection of data for the study was begun in the summer of 1963. At that time there were more than a dozen institutions in North Carolina which offered two years of related course work in technical subjects. However, only graduates of Gaston Technical Institute in Gastonia, North Carolina, had been out of school more than three years. because of the limited amount of postgraduate income data that could be obtained from graduates of other technical schools, only graduates of Gaston Tech were included in the study.

Although Gaston Technical Institute was established in 1952, the 1957-58 academic year marked the beginning of the school's operation as a fully state supported institution offering two-year terminal courses in four fields of technology. From that time it was a coeducational school which awarded degrees of Associate in Applied Science to graduates in Civil, Electrical, Electronics, and Mechanical and Production Technology. The program at Gaston Tech was designed to train technical manpower that could function between the engineer and the skilled craftsman. The four curricula offered at Gaston Tech were accredited by the Engineer's Council for Professional Development. Normal enrollment at the institution was approximately 200 students, and about 60 percent of the enrollees graduated.

From 1957 until the academic year 1965-66, the school was operated by the College Extension Division of North Carolina State University at Raleigh. The academic program and staff appointments were under the supervision of the School of Engineering.

Beginning with the fall semester of 1965 Gaston Tech was administratively merged with the new Gaston Community College. Gaston Community College will offer technical curricula. In addition, more than twenty other institutions offering courses in technical subjects have been established in North Carolina as a result of legislation passed by North Carolina's 1957 General Assembly. Collectively these institutions offer courses in technical subjects comparable to those offered by Gaston Tech. They also offer a wider range of technical curricula and numerous short-term industrial training programs.

The income data collected from both Gaston Tech and high school graduates cover a maximum of seven years. Gaston Tech graduates enrolled for their two years of technical education either in 1957 or 1958, and

graduated in 1959 or 1960. Income data for each graduate were obtained for a period beginning with the date of enrollment and terminating on August 31, 1964. For each Gaston Tech graduate, income data covering the same period of time were collected from a high school classmate who did not invest in formal schooling at the post-high school level.

Selection of Gaston Tech and High School Graduates

High school and Gaston Tech graduates were selected to minimize the problems of estimating costs and returns of technical schooling. Individuals included in the study were chosen to meet the following criteria:

(1) Each graduate could have only the specified high school or technical education, except for military training not closely related to the individual's occupation. Thus, the possibility of formal occupational training beyond high school was restricted to only that received at Gaston Tech for those with technical schooling. High school graduates were not included in the study if they had any formal postsecondary training (other than unrelated military training).

(2) One high school graduate was selected for each Gaston Tech graduate in the study. Each such high school graduate must have graduated in the same high school class as his Gaston Tech counterpart. The high school graduate was also selected only if he had a high school academic record comparable to the classmate who attended Gaston Tech. Selecting high school graduates from the same high school class and with similar academic records provided some control over ability levels, quality of secondary schooling, and geographic and social background of the two groups.

(3) Each person must have been a civilian and employed or seeking employment. If employed, the person must have been employed by someone other than himself but not by a relative. A requirement that persons be in the civilian labor force was necessary to get a market measure of the productivity of high school and Gaston Tech graduates. By excluding persons who were self-employed or working for relatives, the estimated income effects of schooling should not be affected by property income or nepotism.

(4) Each participant could have no permanent disabilities which would obviously limit his range of employment possibilities. Physically disabled persons may reap unusually large returns from investments in schooling because of their forced dependence on mental capabilities rather than physical capabilities. Since the possibility of unusually high returns could not be investigated adequately in the study, the permanently disabled were excluded.

(5) Each person must have been a graduate of a North Carolina high school and employed no more than 200 miles from the community where he graduated from high school. This requirement helped to reduce the cost of collecting data and to make the two groups more homogeneous.

Most of these restrictive criteria did not result in once-and-for-always exclusion of individuals from the study. Income data were not used for any individuals during a period in which some requirement was unsatisfied. Since conditions of employment frequently change, persons could fail to satisfy one or more of the above criteria for periods of various length. Individuals who provided less than 30 months of unrestricted income data were dropped from the study.

Procedure to Obtain Data

Data collection began with the initial selection of Gaston Tech graduates. School records at Gaston Tech were examined to determine which of the 1959 and 1960 graduates would meet the specified requirements of the study. Based on information obtained from school records, 59 of the 120 graduates in the first two classes were considered eligible.

Gaston Tech administrators had kept a fairly accurate employment record on each graduate. Consequently, restrictions on the amount of post-high school education, distance migrated from high school, and other requirements could be checked initially in the school records. Post-high school education prior to enrollment at Gaston Tech was the primary reason for eliminating many of the 1959 and 1960 graduates from the sample.

High school transcripts were available on each of the Gaston Tech graduates. These provided name and location of high school, grades, and scores on aptitude tests (if any had been administered). The second phase of data collection was a visit to each high school

represented to determine if adequate high school prospects were available for each of the 59 Gaston Tech graduates. Prospective high school graduates were compared with the classmate who attended Gaston Tech primarily on the basis of high school grades. Scores on aptitude tests and subjective evaluations by high school faculty members were also considered whenever these were available.

Members of both groups were contacted during the summer and fall of 1963. Whenever a Gaston Tech graduate did not meet the requirements of the study, the corresponding high school classmates were also dropped from further consideration. For this reason, Gaston Tech graduates were normally contacted and interviewed prior to making contact with a high school classmate. Several of the restrictive criteria resulted in complete elimination of prospects from both groups (Table 1).

During the interview with high school and Gaston Tech graduates four kinds of information were recorded: (1) information concerning the restrictions, (2) income and employment history back to the date on which the Gaston Tech graduate enrolled for technical schooling, (3) information on income related characteristics, and (4) general information.

After the initial interviewing was completed a total of 45 Gaston Tech and 45 high school graduates had been included in the study. A second contact was made with each of the 90 sample members in September 1964 to update income and employment information through August 31, 1964.

Although Gaston Tech and high school graduates were selected so the two groups were very similar with regard to several important characteristics, the two groups still were different in many income related characteristics besides education. Consequently, regression analysis was used to further standardize the estimated income effect of investments in technical schooling for differences in several demographic characteristics (Appendix A).

Table 1. Primary causes for eliminating prospects from the sample after initial contact

Cause	Gaston Tech	High School
Other post-high school education	2	36
Military service	3	3
Migration restriction	3	2
Physical handicap	2	2
Privately owned business	1	1
Would not cooperate	1	1
No adequate high school counterpart[a]	2	-
Total	14	45

[a]Applies to Gaston Tech group only.

COSTS OF SCHOOLING[1]

The costs of schooling to society include the loss of productivity (income foregone) by students while attending school plus the cost of providing school facilities, supplies and personnel. However, the procedure for estimating total costs of schooling involved the summing of payments rather than adding up the costs of various factors such as land, building, equipment, supplies, teaching personnel, etc. The total costs of schooling at Gaston Tech were shared by private individuals or organizations and government. Consequently, the total cost of schooling was obtained by adding those costs borne by the student, his family, friends or nongovernmental organizations (private) to the government (public) share of the costs of schooling.

Private Costs

The private costs of two years of schooling at Gaston Tech consisted of cash expenses (tuition and fees, costs of school supplies such as books, paper, pencils, drawing instruments, etc.) and foregone earnings.

The school administration at Gaston Tech provided estimates of the average cash expenditures by students while attending the school. Average payment of tuition and fees for the Gaston Tech graduate of 1959 and 1960 was $136 per semester. The average cost of books and miscellaneous school supplies was $100 per student for the first semester and $42 for subsequent semesters. The estimated costs of student supplies were based on records of a student supply store operated by the institution.

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[1]The cost computations in this section are based on a model enrollment period of 21 months in technical schooling, two nine-month periods of schooling with an intervening summer. There were eight exceptions among the 45 Gaston Tech graduates, but only two persons required more than 18 months of actual schooling. The other six began their schooling in February 1958 so that two summers intervened during the period of schooling. The average period of enrollment for the 45 Gaston Tech graduates was increased by about two weeks as a result of these eight exceptions. Since the entire month of September was treated as a school month, even though schooling normally begins about the middle of September, the actual average period of enrollment was approximately 21 months.

On the basis of four semesters of time to complete the requirements of a curriculum at Gaston Tech, the average outlay per student during his schooling was $544 for tuition and fees plus $226 for books and supplies. No cost was included for room and board because there is little evidence that cost of living is significantly different between students and nonstudents. Consequently, actual expenditures averaged only $770 per student for the four semesters.

While Gaston Tech graduates were attending Gaston Tech they gave up opportunities for employment and income they could have earned if they had been in the labor market as full-time members of the labor force. Another way of describing the foregone earnings in a social context is to use the term foregone productivity. Society gave up the goods and services that could have been produced by Gaston Tech students if they had not been going to school. Of course, society will also benefit from any increase in productivity which results from the schooling, just as the Gaston Tech graduates may earn higher incomes after schooling to offset the loss of income while in school.

The loss of production and earnings while attending Gaston Tech can be estimated for Gaston Tech graduates by observing the difference in the earnings of Gaston Tech students and their high school classmates. The group of high school graduates earned an average of $2,509 while Gaston Tech students obtained their first academic year of schooling. During the summer and second academic year, high school graduates earned an average of $3,604. Since the monthly income effects of several demographic variables were estimated in the regression equation (Appendix A), actual average income earned by high school graduates was adjusted to represent the best estimate of what Gaston Tech students could have earned as high school graduates. The estimate of average labor income which Gaston Tech students could have earned during the school period was $5,934 ($2,447 for the first two semesters and $3,487 for the intervening summer and last two semesters).[1] As students, their actual incomes were considerably less.

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[1]One might expect the estimated potential earnings of Gaston Tech students to be greater than the actual earnings of the high school group. However, readers should be reminded that the high school graduates were selected on the basis of academic performance in high school and consequently were not just "average" high school graduates.

Gaston Tech students earned an average of $39 through part-time employment during the first two semesters of schooling and $135 during the last two semesters. Only four students were employed part-time during their first academic year at Gaston Tech, but 12 worked part-time during the last academic year. Thirty-nine students were employed during summer months between school terms. Summer earnings averaged over the forty-five Gaston Tech students amounted to $563. Thus, during the 21 months from enrollment to graduation, the 45 Gaston Tech graduates earned an average of $737. Since their potential earnings as high school graduates was estimated at $5,934, the estimated total foregone earnings averaged $5,197 per student.

Public Costs

Average private costs of the two years of schooling at Gaston Tech were less than average total costs because public support was received by the school and by some of the students. Nineteen students received G. I. Bill payments while attending Gaston Tech, and three students received unemployment payments during the summer months between their first and second year of schooling. When the total of such transfer payments was averaged over the 45 Gaston Tech students, G. I. Bill payments averaged $1,028 per student and unemployment payments averaged $19 per student. Thus, direct government transfer payments to students reduced the private share of the total cost of schooling by $1,047. Average private cost of the two years of schooling at Gaston Tech was $4,920 (Table 2).

Table 2. Average private cost and government transfer payments per Gaston Technical Institute student by enrollment year, type of cost or transfer payment, 1957-1960

Type	1st year	2nd year	Total
		(dollars)	
Cash expenses	414	356	770
Foregone productivity	2,408	2,789	5,197
Less government transfer payments			
G. I. Bill payments	-512	-516	-1,028
Unemployment payments	---	-19	-19
Total	2,310	2,610	4,920

In addition to transfer payments to students, a large share of the costs of schooling at Gaston Tech was publicly financed through state appropriations for the operation and maintenance of the school. The public costs of operation and maintenance of Gaston Tech amounted to an average annual sum of $145,848 during the school years 1957-1960.[1] Based on an average enrollment of 200 students during this period, public support of the school for two years averaged $1,458 per student. Thus, average total public costs for G. I. Bill and unemployment transfer payments ($1,047) plus public support of Gaston Tech ($1,458) amounted to $2,505.

Budgeted costs did not include opportunity costs or depreciation of physical plant. The buildings in use at Gaston Tech were very old structures. It seemed unlikely that further depreciation of physical plant could more than offset appreciation of site value. Opportunity costs of capital could have been estimated independently and added to state appropriations. However, budgeted costs for repairs and maintenance in 1957 exceeded by approximately $21,000 the average amount allotted to this category in succeeding years. In the writers' opinion, the opportunity return on real estate and physical capital employed at Gaston Tech would have been approximately this amount over the three-year period from 1957 to 1960. Consequently, budgeted costs financed through state appropriations were taken without adjustment as a good estimate of the public cost of providing school facilities and personnel.[2]

Total Costs

The sum of average private costs for the two years of schooling at Gaston Tech ($4,920) and public costs ($2,505) equal average total costs ($7,425). However, the costs can also be divided into (1) costs of school facilities, supplies and personnel, and (2) foregone productivity of students (Table 3).

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[1] The Budget, 1959-1961, Vol. 1, North Carolina Budget Division, State of North Carolina, Raleigh, 1959, pp. 327-328.

[2] If costs were computed for technical education provided by an institution with more modern physical plant, annual state appropriations should be augmented by a depreciation allowance and interest on investment in physical facilities. However, different circumstances with regard to input components might also result in different returns on investment.

The average cost of school facilities, supplies, and personnel for the first year was obtained by adding the average public support of the school for that year ($1,458/2 = $729) to student payments for tuition, fees, books and other supplies during the first year ($414). Similarly, for the second year public support of the school was estimated at $729 per student, but average expenditures for books and supplies were $58 less. The estimated average loss of productivity for students while in school (Table 3) is the same as presented earlier in Table 2. The total loss of productivity and costs of facilities, supplies and personnel includes all of these costs which were either publicly or privately financed and, hence, yields the estimated average total cost ($7,425).

Table 3. Average total cost per Gaston Technical Institute student by enrollment year and type of cost, 1957-1960

Item	Foregone productivity	School facilities, supplies and personnel	Total
	(dollars)		
1st year[a]	2,408	1,143	3,551
2nd year	2,789	1,085	3,874
Total	5,197	2,228	7,425

[a]Costs for the first year included only those applicable to the first two semesters of schooling. Summer months were counted in the second year.

INCOME DIFFERENCES

The average monthly income of Gaston Tech graduates was higher and less variable (Appendix B) than that of high school graduates immediately after technical schooling. The initial difference in monthly incomes (unadjusted for demographic differences) was only $11, but the gap widened rapidly over time. At the end of the first year of postgraduate employment the Gaston Tech group was earning an average of $56 per month more than high school graduates. In four years the difference had increased to $107 per month (Figure 1).

Unemployment for a single individual in a particular month could noticeably affect the average income for that month. However, as a factor in determining total costs and returns of technical education, unemployment was not important. High school graduates had less than 0.3 percent unemployment and Gaston Tech graduates had less than 0.2 percent unemployment.[1]

Fringe Benefits

In addition to the pecuniary income advantage, Gaston Tech graduates apparently had more fringe benefits. An attempt was made to determine the fringe benefits associated with employment for both groups. Like income, fringe benefits can vary over time for an individual even while he continues working for the same employer. Since only crude measures of fringe benefits can be provided, one summary was made for both groups which applies to employment as of June 1, 1963 (Table 4).

Based on estimates provided by each individual, Gaston Tech graduates apparently had greater quantities of the positive benefits associated with employment and less of the negative benefits (costs). The real value of a specific type of fringe benefit is difficult to estimate because the value depends on individual preferences and needs. For example, the availability of large quantities of paid sick leave would probably be considered as having greater value to persons who tend to have frequent or prolonged illnesses than to persons who seldom are sick.

Although there are serious difficulties in estimating the monetary value of a fringe benefit, a fairly straightforward method was available for estimating the value of different quantities of leisure available to the two groups. There were two reasons for making such an estimate. First, the conditions under which the value of leisure would be

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[1]Unemployment is defined as the number of man-days in which people were without jobs as a percent of total man-days in the data period.

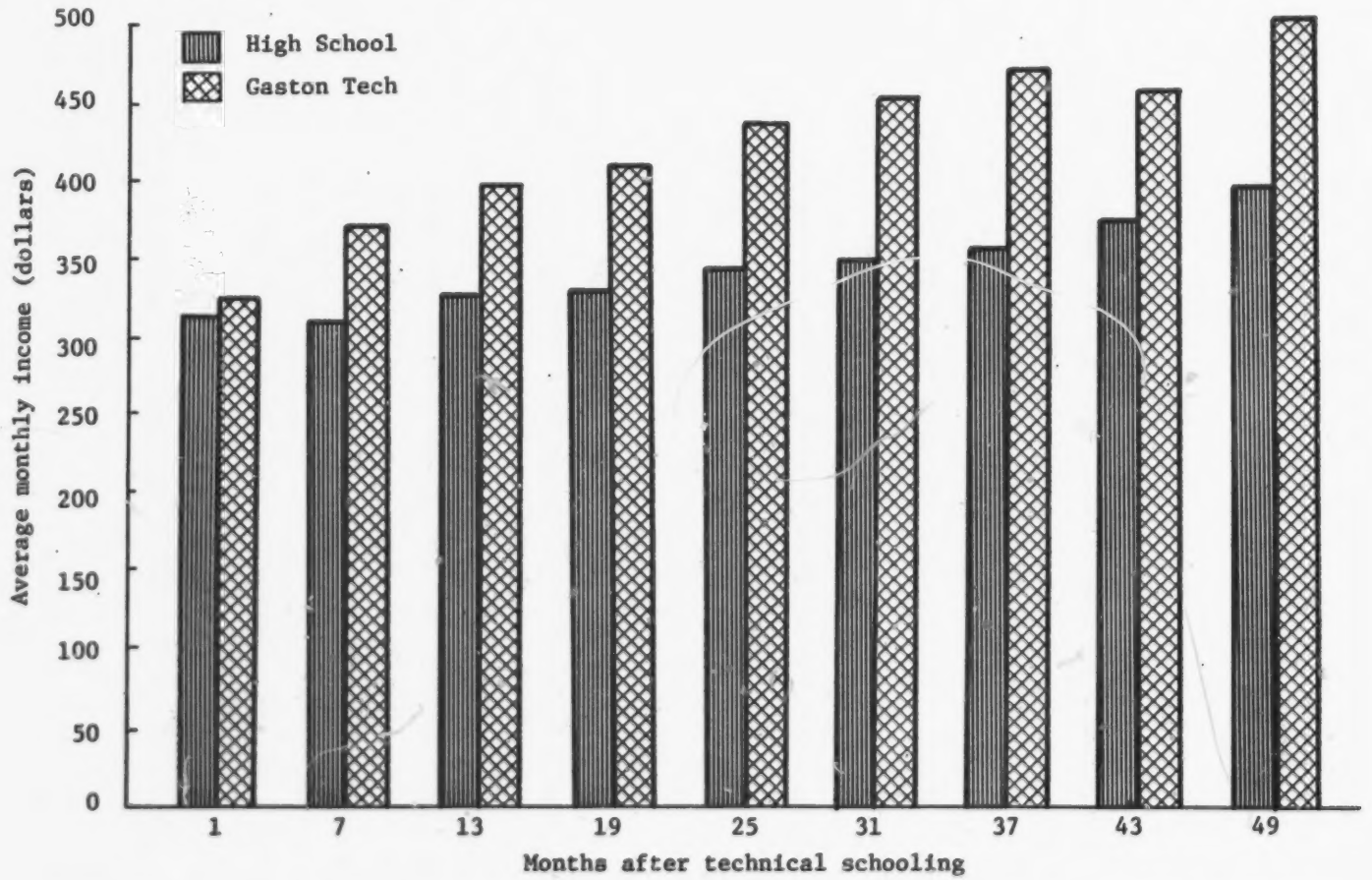

Figure 1. Average monthly incomes of Gaston Tech and high school graduates at six-month intervals after Gaston Tech graduates had completed two years of technical schooling

Table 4. Summary of fringe benefits for employment as of June 1, 1963

Item	Unit	Gaston Tech[a]	High school
Average working time (required hours)	hours/wk.	40.5	43.2[b]
Receiving paid overtime	persons	21	19
Average overtime (for those with)	hours/wk.	3.9	4.4
Receiving no paid vacations	persons	1	2
Average paid vacation per graduate	days	9.8	8.9
Receiving no paid holidays	persons	3	7[c]
Average number of paid holidays per graduate	days	6.7	5.5
Receiving no paid sick leave[d]	persons	9	13
Average maximum paid sick leave (for those with)[e]	days	30	24
Having to furnish durable capital[f]	persons	9	8
Average amount of durable capital (for those furnishing)	dollars	35	142
Having to furnish nondurable capital[g]	persons	0	2
Average annual amount of nondurable capital (for those furnishing)	dollars	--	38
Employer sponsored insurance	programs	42	38
Participating in sponsored life insurance	persons	39	36
Employer's average share of life insurance premiums (for those sponsoring)[h]	percent	81	71
Participating in sponsored hospital insurance	persons	42	36
Employer's average share of hospital insurance premium (for those sponsoring)[h]	percent	72	71

Table 4 (continued)

Item	Unit	Gaston Tech[a]	High school
Employer sponsored retirement	programs	37	27
Employer's share of contributions to retirement (for those sponsoring)[h]	percent	86	82

[a]Three Gaston Tech graduates were in restricted categories as of June 1, 1963, and were not included in this table.

[b]Average does not include information for one high school graduate who did not work regular hours and received payment on a piece rate basis.

[c]Two of the seven high school graduates received extra pay for working holidays.

[d]In addition to those who did not have paid sick leave, six Gaston Tech graduates and seven high school graduates did not know whether paid sick leave was available or not.

[e]Average does not include information for five Gaston Tech graduates and three high school graduates who claimed to have an unlimited amount of paid sick leave.

[f]Durable capital includes tools and other hardware which, with normal care, could be used for several years.

[g]Nondurable capital includes items of clothing.

[h]The number of Gaston Tech graduates who did not know their employer's share of premiums was as follows: life insurance (15), hospital insurance (17) and retirement (18). The number of high school graduates who did not know their employer's share of premiums was as follows: life insurance (12), hospital insurance (15), and retirement (8).

overestimated or underestimated can be made explicit. Second, the estimated annual value of the difference in leisure is large relative to differences in money income.

The normal work week of high school graduates averaged 2.7 hours per week more than for Gaston Tech graduates. The average amount of paid vacation and paid holidays per year was greater for Gaston Tech than for high school graduates. Gaston Tech graduates averaged 9.8 days of paid vacation and 6.7 paid holidays per year. Comparable figures for high school graduates were 8.9 and 5.5 days, respectively. Thus, on an annual basis, the Gaston Tech graduates had an average of 157 hours more leisure available because of a shorter work week, longer paid vacations and more paid holidays.

It is necessary to make some assumptions in order to assign a value to the difference in leisure. An estimate was obtained by assuming the average value of leisure time to be the same for the employee as his labor time. In this manner the greater amount of leisure time available to Gaston Tech graduates could be valued at the average hourly earnings rate ($2.84) for the group. Using this method the additional leisure available to Gaston Tech graduates would have a value of $446 per year.

Average hourly earnings would tend to overvalue leisure if Gaston Tech graduates were willing to work the additional hours for less than their average rate of pay. On the other hand, Gaston Tech graduates might be unwilling to work the extra hours unless they were paid a higher than average rate. If the latter is true, leisure time would have a higher value than estimated above.

The authors feel that $446 is a conservative estimate of the annual value of additional leisure time available to Gaston Tech graduates, and is substantially less than the annual value of all the increased fringe benefits received by Gaston Tech graduates.

Projected Income Differences

When the $446 allowance for fringe benefits is added to the regression estimates (Appendix A), the income advantage of Gaston Tech graduates in the first four years after technical schooling was $999, $1,160, $1,321 and $1,482, respectively. However, four years after technical schooling the average age of Gaston Tech graduates was only 27. If most of the

graduates continue to work until age 65, the major share of returns on investment in technical education will be earned over the remaining part of their working life. Thus, some estimate of future returns must be made before any estimates can be made of the capital value of technical education.

Two projections of future returns were made. The first is a rather conservative projection based on the assumption that future incomes and fringe benefits of high school graduates will increase just as much as for Gaston Tech graduates. According to such an assumption Gaston Tech graduates reached their maximum income advantage over high school graduates in the fourth year after graduation from Gaston Tech. The income advantage of $1,482 was projected over the remaining part of the working period until retirement. Thus, the annual income advantage of $1,482 was projected for 38 years to retirement age 65.

A projection of the income difference does not necessarily imply a particular rate or direction of change in the incomes of either group. Projection number one could be accurate under conditions of rising, constant or falling incomes provided the annual difference in average incomes remains $1,482.

A second projection was made on the basis of cross-section income data taken from the 1960 census (Table 5). Differences in the annual earnings of persons by age and level of education at a moment in time do not provide a true picture of the income pattern of persons aging over time. Growth in productivity and earnings over time are not necessarily uniform by age, education or occupation. To adjust the cross-section data in Table 5 for secular growth, earnings were assumed to grow at a constant percentage rate over all age, education and occupation categories. An annual growth rate of 2 percent was applied to the data in Table 5. The average age of Gaston Tech and high school graduates in 1959 was 22 years. Therefore, mean earnings in Table 5 were adjusted upward at the rate of 2 percent per annum for the number of years that will elapse from 1959 until sample members reach the midpoint of each age category. The resulting income estimates were then used to derive estimates of the average annual growth in the income difference from one age to the next (Table 6). The figures in column six of Table 6 were then used to project the future income advantage of Gaston Tech graduates.

Table 5. Mean earnings of southern white males in the experienced civilian labor force by age and years of school completed, 1959[a]

Age	High school	1-3 years of college	Difference	Average annual change
		(dollars)		
25 - 34	5010	5347	337	
				76
35 - 44	5822	6919	1097	
				43
45 - 54	5853	7383	1530	
				-6
55 - 64	5528	7000	1472	

[a]The census definition of earnings includes income earned as wages, salary, commissions, tips, and profits or fees from self-employment.

Means were computed exclusive of three occupational categories which, by census difinitions, have a relatively high proportion of self-employed. The categories excluded were: (1) farmers and farm managers, (2) managers, officials, and proprietors, except farm, and (3) farm laborers and foremen. Source: U. S. Bureau of the Census (1963, pp. 220 - 237).

Table 6. Projected mean earnings of southern white males in the experienced civilian labor force by age and years of school completed[a]

Age	Years of growth	High school	1-3 years of college	Difference	Average annual change
			(dollars)		
30	8	5,870	6,265	395	
					117
40	18	8,315	9,882	1,567	
					110
50	28	10,190	12,854	2,664	
					46
60	38	11,732	14,856	3,124	

[a]Assuming an average age of 22 years in 1959 and a 2 percent rate of growth in annual earnings.

Future returns on the investment in technical education may be small for some Gaston Tech graduates. The income advantage estimated for the first four years after graduation has already been earned. Any income advantage projected for future years can only be earned by Gaston Tech graduates who are working during those years. Gaston Tech graduates who do not live to retirement age or become disabled could not obtain all the projected returns from their investment in technical education.

The probability of preretirement deaths can be estimated from survival data. In 1962, the Bureau of Vital Statistics published the number of survivors by age from 100,000 live, white male births. The average age of the group of Gaston Tech graduates in 1964 was 27 years. Survival rates used to adjust projected returns were computed by dividing the number of 27-year old white male survivors into the number of survivors at each subsequent age up to 65. The resulting figures represent the best current estimate of the probabilities of a 27-year old white male living to any particular age from 27 to 65. Mortality rates were assumed to be the same for Gaston Tech and high school graduates. Mortality rates are probably lower for people with higher education because of differences in the types of occupations, expenditures on health care, and other factors related to level of education or income. However, any difference in the future mortality rates of Gaston Tech and high school graduates was expected to be negligible because the difference in formal education is only two years.

After the survival rates were computed, each year's projected annual income differential was multiplied by the probability of survival to the corresponding age. For example, the probability of a 27-year old white male reaching age 65 is computed by the above procedure to be .69. Thus, the probability of a Gaston Tech graduate living to earn the income advantage projected for the last year before retirement is approximately .69. When the projected earnings were multiplied by survival rates, the returns from investment in technical education were adjusted for one of the important risks affecting the value of human capital -- the uncertainty of life.

The use of historical survival data probably resulted in an overestimate of future mortality rates because there was no adjustment for scientific advancements that tend to increase life expectancy.

However, other employment reducing factors such as disability and early retirements may offset the overadjustment for mortality. As in the case of mortality, Gaston Tech and high school graduates may have a different rate of incidence for such factors. To the extent that Gaston Tech graduates have a lower incidence of these employment reducing factors than high school graduates, as would normally be expected, the returns estimated for investments in technical education are conservative.

VALUE CREATED BY INVESTMENT

When all costs and returns of a business venture occur within a short period of time, such as one year or less, the profit or loss is easily determined. However, when costs or returns occur over a period of several years, the gain or loss from such a business venture is not so easily determined. In fact, given estimates of costs and returns, different criteria may be used in choosing among alternative investment opportunities. Three measures of the value created by investments in technical schooling are discussed.

Total Return

The average social investment per Gaston Tech graduate was $7,425. After adjustments for mortality rates, the estimated average lifetime income gain from the investment in technical schooling was $56,357 for projection number one and $123,570 for projection number two. The ratio of estimated lifetime return is 7.6 to 16.6 times as large as total costs for projections one and two, respectively. If only private costs are considered, the ratio of returns to costs is 11.4 and 25.1 for the two projections.

By either projection the costs are repaid several times. The rate of initial payoff on the investment is also high for both projections of future returns. A maximum of 6 years would be sufficient for repayment of the total costs and only four years for private costs.

Rates of Return

Returns obtained over a long period of time or rates of pay-off do not provide any precise measure by which to choose among investment or

comsumption alternatives. The rate of return is a criterion often used because it indicates the equivalent annual yield of an investment. Thus, rate of return is one way to convert costs and returns over several time periods into a rate of change over time.

The rate of return on investment in technical education was obtained by finding the rate of discount which would reduce the costs and returns to equal value in the initial time period of the investment. Such a rate of discount is called the "internal rate of return." The internal rate of return is a good criterion for evaluating investment alternatives of equal life provided the costs all occur in or near the initial time period.

The rate of return on the total investment in technical schooling of Gaston Tech graduates was estimated at 16.7 percent for projection one and 20.1 percent for projection two. The rate of return on private investment was even higher than the rate of return on total investment. All the returns estimated accrue directly to the Gaston Tech graduates but not all the costs. Only $4,920 of the $7,425 average cost for the two years of technical schooling was financed by the Gaston Tech graduates. The private rate of return was obtained by discounting the returns using $4,920 as the amount of investment. Consequently, the rate of return was 23.9 percent for projection one and 25.9 percent for projection two. Thus, the private rate of return is considerably higher than the rate on total investment.

Capital Value

The most widely accepted criterion for choosing correctly among investment and consumption alternatives so as to maximize individual welfare is maximization of present value. The present value of an individual's future income depends upon the individual's preference for present consumption. However, when considering investment as a means for increasing future income, the investment may be financed from past savings, current income or by borrowing. Thus, the cost of financing an investment may be determined by an individual's time preference for consumption (expressed as a rate), the rate of return that could be earned if alternative use is made of accumulated resources, and/or the rate at which one may borrow additional resources. Since these rates vary among individuals and groups that differ in wealth, age, etc.,

no single interest rate can be said to represent the cost of financing an investment for that group. Two rates were used in this study to illustrate the magnitude of capital value created when some specific rate of cost for financing an investment is assumed.

Five percent was used because long-term loans of low risk usually earn a rate of interest in the neighborhood of 5 percent. A second discount rate of 10 percent was chosen to contrast the effects of low and high discount rates on the capital value of technical education. The 10 percent is less than that normally charged on short-term, time-payment loans of commercial banks, but considerably higher than the average rate for long-term investment funds.

When the total returns for projection one were discounted at 5 percent, a capital value of $22,763 was obtained.[1] Thus the capital value was $17,967 more than the discounted private costs and $15,523 larger than the discounted total costs (Table 7). For projection two and a discount rate of 5 percent the capital value and a capital gain were even larger. Assuming a discount rate of 10 percent, the average capital value of the technical schooling using either projection was still greater than private or total costs. The discount rate could go as high as those presented in the previous section before the average capital value would be less than the average investment in schooling.

Table 7. Average capital value and capital gain from investments in technical education by projection and discount rate

Discount rate	Capital value	Capital gain	
		Private	Total
		(dollars)	
Projection One			
5 percent	22,763	17,967	15,523
10 percent	12,230	7,547	5,157
Projection Two			
5 percent	40,953	36,157	33,713
10 percent	18,567	13,884	11,494

[1]Capital value may be defined as the present value of the future net income to be derived from a durable asset.

SUMMARY AND CONCLUSIONS

In a recent study conducted by the Department of Economics at North Carolina State University, estimates were made of the costs and benefits of two years of postsecondary, technical schooling for 45 white, male graduates of Gaston Technical Institute. Income received by the graduates as a result of their two years of technical schooling was used in computing rates of return on the average investment made per student. Both public and private costs were considered.

Gaston Technical Institute, located in Gastonia, North Carolina, began operating as a two-year technical school in 1957. The school was administered by the College Extension Division of North Carolina State University with staff appointments and the academic program supervised by the School of Engineering. The 45 graduates had completed their two years of schooling in either 1959 or 1960, and were awarded the degree of Associate in Applied Science in one of four curricula offered at Gaston Tech: civil technology, electrical techology, electronics technology, and mechanical and production technology.

In 1965 Gaston Tech was administratively merged with Gaston Community College, one of the many postsecondary institutions which have recently been established in North Carolina as a result of legislation passed by the 1957 General Assembly. Collectively these new institutions offer a wide range of technical curricula and short-term industrial training programs.

There are several difficulties involved in estimating the return on investment in schooling. Personal characteristics as well as many kinds of physical resources can affect incomes of individuals. One of the first problems in examining the value of any amount or type of schooling is to distinguish income earned as a result of the schooling. Thus, income effects of schooling must be separated from the income effects of other human or physical capital possessed by persons with schooling.[1]

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[1] In addition to formal schooling, human capital may be created by investments in such things as health care, on-the-job training, migration, market information, etc.

Individuals investing in technical schooling may derive benefits other than increased money income. Such things as better working conditions, longer paid vacations, and any personal satisfaction derived from increased knowledge as a result of schooling are examples of nonmonetary benefits. Likewise, people who do not obtain a particular unit of schooling may be affected. They may experience increased productivity or a direct increase in consumption as a result of the schooling obtained by others. Measuring the indirect effects of schooling on people who did not have the schooling is an extremely difficult, if not impossible, task.

Even though little progress has been made in determining how much a person's nonmonetary income is affected by schooling and in measuring the effects of his schooling on other people, much progress has been made in calculating the direct money income earned as a result of schooling. In this study of Gaston Tech graduates several techniques were used to guard against counting as returns to technical schooling any income which could be reasonably attributed to other factors.

To measure the income effects of schooling, the incomes earned by Gaston Tech graduates were compared with the incomes of a group of 45 high school graduates. To make the income comparison more meaningful, high school graduates who were selected had formerly attended the same high school and were in the same graduating class as one of the Tech graduates. Thus, for each Gaston Tech graduate included in the study there was a high school graduate who had a similar academic record in the same high school and graduating class. By selecting high school graduates in this manner, it was possible to compare a group of Gaston Tech graduates with a group of high school graduates of comparable academic ability and geographic background. By means of regression analysis the differences in income between high school and Gaston Tech graduates were further standardized for sources of variation in the quality of home and community environment, academic performance in high school, civilian and military experience, and investments in migration.[1]

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[1]Investment in on-the-job training may follow the investment in schooling. Individuals generally invest in on-the-job training by taking less pay than they could earn in other employment. Since the

Resources used in the postsecondary technical schooling included services of students, teachers, administrative and service personnel of the school, physical facilities, school equipment, and books and supplies. Costs of the resources used were financed from public and private sources. Students incurred direct costs for tuition, books and supplies.[2] Students also had indirect costs in the form of foregone earnings.

Average tuition during the two years at Gaston Tech was $544 per student. Books and supplies averaged $226. Thus, student expenditures were only $770 per student for the four semesters of schooling.

An estimate of income foregone by students was obtained by subtracting student earnings in part-time and summer employment from the earnings of the group of high school graduates. In addition to the cash expenditures, students gave up $5,197 of income on the average while attending Gaston Tech.

State appropriations for operation and maintenance of Gaston Tech averaged $145,848 per year in the period 1957-1960.[3] With an average enrollment of 200 students, public payments for two years of operation and maintenance of the school amounted to $1,458 per student.

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[1](continued) reduced salary is only for the duration of the training period and the prospects of higher salary after training are good, the income foregone should be treated as an investment in on-the-job training. However, it is often difficult to determine whether or not an employer provides on-the-job training, how much of the cost is paid directly or indirectly by the employee, and whether or not technical schooling is a prerequisite for the particular type of on-the-job training. Thus, loss of income during periods of informal job training have been implicitly counted in the returns to education and no estimate of separate investments made in on-the-job training is available.

[2]Costs of living were not included as costs of schooling because such costs occur for everyone whether student or nonstudent. There is little evidence to suggest that students require different amounts of food, clothing, or shelter than nonstudents.

[3]The Budget, 1959-1961, Vol. 1, North Carolina Budget Division, Raleigh, 1959, pp. 327-328.

The average total cost per student for providing school facilities, equipment, books, supplies and school personnel amounted to $2,228. When the $2,228 was added to the average income foregone by students during the two years of schooling ($5,197), an average total cost per student of $7,425 was obtained. Thus, foregone income accounted for 70 percent of the total cost of schooling.

One-third of the total cost of technical schooling for the 45 Gaston Tech graduates was paid from public funds. In addition to state support of Gaston Tech ($1,458 per student) there were government transfer payments to nineteen students who were Korean veterans and unemployment payments to three students during summer months. When averaged over the 45 Gaston Tech students, G. I. Bill payments amounted to $1,028 and unemployment benefits $19. Thus, $2,505 of the $7,425 cost per student was paid with public funds. The remaining $4,920 represents the average cost which was borne by the student, his family, friends, or other private agencies.

Gaston Tech graduates earned an average of $573 more than the high school graduates in the first year after technical schooling. After adjustments had been made to exclude income differences caused by factors other than schooling, average monetary returns to technical schooling in the first year following graduation were estimated to be $555. The average monetary returns increased by $161 per year during the first four years after technical schooling. Thus, in the fourth year Gaston Tech graduates had an estimated money income average of $1,038 attributable to technical schooling.

Gaston Tech graduates also had many advantages in fringe benefits such as a shorter work-week, more paid vacation, holidays and sick leave, greater amounts of insurance benefits and increased retirement benefits. While it is difficult to place a monetary value on the host of fringe benefits, a conservative estimate of only the value of additional leisure available to Gaston Tech graduates was $446 annually. When added to the money income average already estimated, the total returns on technical schooling in the first four years after graduation increased from $3,186 to $4,970.

Since data on returns were obtained for only a four-year period, two projections were made of returns to be received in the future by the Gaston Tech graduates. For the first projection the income advantage earned by Gaston Tech graduates in the fourth year after technical schooling, including $446 for fringe benefits, was projected to retirement age 65. Such a projection probably provides a very conservative estimate of the future returns to Gaston Tech graduates for it would seem unlikely that incomes of high school graduates and Gaston Tech graduates will increase by equal dollar amounts over time.

A less conservative projection was made based on a 1960 census report of the earnings of southern white males by age and education. In this projection the future income advantage of Gaston Tech graudates increased until retirement age 65.

Projected returns from technical schooling were adjusted downward according to mortality rates published by the Bureau of Vital Statistics. The estimated lifetime return, adjusted for mortality risks, was $56,357 per Gaston Tech graduate for the first projection and $123,570 for the second projection. For both projections the estimated average lifetime return to Gaston Tech graduates is several times larger than the average total cost of technical schooling ($7,425).

However, it may be more meaningful to ask what rate of return is obtained on the investments in technical schooling. The rate of return on the total investment in two years of technical schooling for Gaston Tech graduates was 16.7 percent for the first projection (constant annual return) and 20.1 percent for the second projection in which salary differentials increased over time. Since private costs were less than total costs, the rate of return on private investment ($4,920 per graduate) was considerably higher than obtained for total investment. Assuming that Gaston Tech graduates received future returns per year equal to the estimated income advantage in the fourth year after graduation from Gaston Tech, the estimated private rate of return is 23.9 percent. For future returns consistent with the second projection, the estimated rate of return on private investment is 25.9 percent.

The rates of return estimated for investments in technical schooling are probably conservative. The estimated returns did not include the positive effects that technical schooling of some workers may have had

on the incomes of other workers. The value of only one type of fringe benefit (leisure) was included. Nevertheless, some precautions should be taken in the interpretation of the study results.

First, the costs, returns, and rates of return were averages. Consequently, the resultant estimates of costs and returns cannot be considered adequate for predicting costs and returns for individual investors in technical schooling. The incomes of high school and Gaston Tech graduates were highly variable. The largest cost component (foregone income) and all the monetary returns were estimated on the basis of average earnings by high school and Gaston Tech graduates. Individual graduates of Gaston Tech may be experiencing returns on investment in technical schooling which are much higher or much lower than the average. Two of the Gaston Tech graduates were actually earning less after technical schooling than the estimate of what their earnings would have been as high school graduates. Apparently the two graduates had negative money returns during the first four years after technical schooling.

Gaston Tech preceded the many postsecondary technical schools established in North Carolina as a result of 1957 legislation. Consequently, the number of people in North Carolina's civilian labor force who have had technical schooling at the intermediate postsecondary level has increased rapidly in recent years. While demand for people with such training may have increased even more than supply, without current estimates one should be careful not to assume that technical school graduates of today will obtain rates of return as high as those estimated for Gaston Tech graduates. Current and frequent measures of the return on investments in postsecondary schooling would certainly provide a more sound basis for the decisions of individuals as well as educators and policy making bodies. A comprehensive follow-up program for high schools and postsecondary educational institutions in North Carolina might be appropriate so that changes in the earnings differential between groups with different levels or types of schooling can be detected quickly. The resources invested in education annually are so large that even slight improvements of efficiency could be very valuable.

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APPENDIX A

By a priori reasoning the money income of an ith individual during a given period of time (Y_{it}) is a function of many variables (X_{itz}) as illustrated by equation (1).

$$(1) \qquad Y_{it} = f(X_{it1}, X_{it2}, X_{it3}, \cdots, X_{itz})$$

The X_{itz} represent characteristics of the ith individual at time period t. The complete model would include such previously mentioned characteristics as cognitive and social abilities, manipulative skills, motivation, physical property, health, location, etc.

The objective of this study was to estimate the functional relationship between two years of technical schooling and the incomes of recipients. If there were no evidence of correlation between the level of education and other variables affecting income, a single comparison of the incomes between people with technical education and those with only high school education would suffice.

The primary objective in regressing monthly income on several variables in addition to level of schooling was to estimate the relationship between income and level of schooling net of any effects caused by variation in characteristics that are correlated with level of schooling.

Five questions were applied in choosing variables to include in the regression equation.

(1) What characteristics would affect the level of labor earnings of an individual?

(2) Which of the characteristics were likely to be present in larger quantity among individuals who elected to take higher education than among people who stopped their formal schooling upon graduation from high school?

(3) What characteristics should be included in the regression equation to help interpret and supply the results of analysis even though the characteristic might not be correlated with the level of schooling in this study?

(4) For the characteristics selected by criteria (2) and (3), which ones could be formulated directly into continuous or discrete variables for analysis?

(5) If it was impractical to obtain a direct representation of any characteristic, was there an indirect or "proxy" variable that could be used (which was highly correlated with the characteristic that should be analyzed)?

Many characteristics were considered in answer to the first question. However, the number was rapidly reduced when each was considered in relation to question (2) and the necessary limitations of available data. There was less problem in deciding what characteristics should be represented in the regression analysis than in formulating the variables that would serve the purpose. Thus, questions (4) and (5) were the most difficult.

Question (3) was used to distinguish between the two purposes for which variables were included in the regression. Variables such as age and high school grades were well balanced between the two groups. Consequently, including such variables in the regression analysis was not expected to alter the estimated income coefficient for technical schooling. Nevertheless, such variables are related to level of income, and the coefficients may be used to estimate costs and returns under alternative conditions. Also, the size and significance level of a coefficient is an indication of whether or not the variable could have biased the estimated income effect of schooling if it had been ignored.

Technical schooling (X_1) was used as a variable by assigning the value of zero for high school graduates and one for Gaston Tech graduates. The coefficient of technical schooling is the estimated effect of technical schooling upon monthly income immediately after graduation (Appendix A Table 1).

The other variables in the regression equation represent characteristics (other than years of schooling) that can affect earnings. High school grade average (X_2) was used as one measure of ability. High school graduates were selected on the basis of a grade average comparable to that of the classmate who went to Gaston Tech. Nevertheless, perfect matching was impossible, and the variable was included in the regression equation to further standardize on ability differences measured by grades.

High school grade average was based on the core of academic subjects required for a high school diploma. It was felt that grade averages were more likely to represent differences in ability and motivation if they were based on common subjects. Even so, the possible variations

Appendix A Table 1. Regression coefficients and standard errors

Variable[a]	Coefficient	Standard error
	(dollars per month)	
Technical schooling (X_1)	38.98**	4.63
High school grade average (X_2)	15.76**	2.23
Age-experience (X_3)	18.38**	.44
Mother's schooling (X_4)	9.43**	.48
Residence during high school (X_5)	31.77**	2.53
Military service (X_6)	-1.53**	.08
Migration from home community (X_7)	.23**	.03
Size of high school class (X_8)	- .08**	.01
Trend - Gaston Tech (X_9)	3.42**	.09
Trend - high school (X_{10})	2.30**	.09
Constant term	-320.82	
Standard error or regression ($Y.X_{1-10}$)	72.43	
Fraction of total variation explained by regression (R^2)	.55	

[a]Variables were assumed to have a linear relationship to income. Thus, the regression equation was of the form:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10}$$

where monthly income (Y) is equal to some constant (a) plus some multiple (b_i) of each of the independent variables (X_i) in the equation.

**Coefficients are significant at the .01 level.

in quality of teaching and academic standards between high schools could not be eliminated.

Several different grading systems were encountered at the high schools. The grade average on required subjects was formulated by weighting the various grades and then computing the average as a ratio to the number of credits. Ratios were obtained by assigning the following weights to grade classifications: A (superior) = 4, B (excellent) = 3, C (good) = 2, D (fair) = 1, F (failure) = 0.

Unfortunately, intelligence and aptitude tests were not administered by all North Carolina high schools in the 1950's. Consequently, high school grade ratios provided the most direct measure of cognitive ability. Grades probably represent a combined measure of an individual's ability to comprehend and his willingness to work. Both of these factors should be positively correlated with earnings. Nevertheless, cognitive ability may be more important to those going into occupations requiring considerable technical knowledge. For this reason, I. Q. scores might have provided a very valuable separate measure of cognitive ability if they had been available for all the high school and Gaston Tech graduates.

Age (X_3) was balanced for the two groups since high school and Gaston Tech graduates were paired by high school graduating class. Nevertheless, an estimate of the effects of maturity and work experience on earnings was desired. Age at time of enrollment in Gaston Tech was selected as the variable to represent both these characteristics.

Mother's schooling (X_4) may affect the informal education, physical and emotional health, motivation, and market information of children. Farther's schooling should have similar effects, but sample members frequently were unable to supply information regarding their father's education. Only mother's education, in years of school completed, was used in the regression.

Residence during high school (X_5), urban versus rural, was included to represent variations in the quantity and quality of community investments in health and recreation facilities, social environment, market information, etc. It was hypothesized that the quality and quantity of such investments would tend to increase as one goes from a rural to an urban environment. Residence during high school was assigned the value of zero if it was primarily rural and one if urban.

Military service (X_6) was included in the regression equation as the number of months of active duty. If one considers the occupational as well as disciplinary training given in the Armed Forces, he would generally expect these to have positive effects on an individual's income earning capacity. However, persons who had military training that was closely related to their occupation were excluded from the study. The negative coefficient signifies lower income for those with greater length of military service. Since length of post-high school experience varies directly with age, the negative coefficient may simply indicate that military service time is inferior to civilian employment when the income effects are considered only for members of the civilian labor force whose military training is not closely related to their civilian employment.

Migration (X_7) was quantified as the number of miles between a person's place of employment and the high school from which he graduates. Migration is a form of investment in people because it is a means of raising a person's earning ability by changing his location. Consequently, a positive relation was expected between migration and income. Migration was more closely correlated with technical schooling than other variables in the regression, except trend (Appendix A Table 2).

On-the-job training is also a type of investment in human capital which probably should be distinguished from the investment in technical education. It was impossible to make such a distinction in this study. Periods of investment in formal on-the-job training are often indistinguishable from normal work experience. Measurement of the effect of formal job training on the time pattern of earnings is even more difficult. Consequently, the costs and returns of employee investments in on-the-job training are inseparable from the costs and returns of technical education. To the extent that the two types of investments are interdependent, there is some justification for measuring the combined effects of the two. Mincer found evidence of a positive correlation between the amount of investment in schooling and investment in on-the-job training.[1] Although inconclusive, Mincer's estimated rates of return

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[1] J. Mincer, "On the Job Training: Costs, Returns, and Some Implications," Journal of Political Economy, Vol. 70, (Supplement) 1962, pp. 50-79.

Appendix A Table 2. Simple correlations of regression variables

Variables	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	Y
X_1 - schooling	1.0	.10	.00	.20	.05	.22	.57	.01	.78	-.78	.39
X_2 - grades		1.0	-.30	.03	-.30	-.16	.22	-.38	.05	-.09	-.01
X_3 - age			1.0	-.13	.03	.55	-.07	.02	.02	.01	.35
X_4 - mother's schooling				1.0	-.08	.01	.16	-.05	.15	-.16	.19
X_5 - residence					1.0	.02	.04	.47	.04	-.02	.10
X_6 - military service			1.0	.09	.04	.21	-.14	.15			
X_7 - migration				1.0	-.04	.41	-.44	.27			
X_8 - size of class					1.0	.00	.01	-.04			
X_9 - trend - Gaston Tech						1.0	-.61	.53			
X_{10} - trend - high school							1.0	-.15			
Y - monthly income								1.0			

for on-the-job training were approximately the same as rates estimated for investment in college education. His results suggest that estimates of the social rate of return for either type of investment are probably biased very little when the two investments are treated as one. Since a share of investment in education is publicly financed, treating the two investments as one would result in an underestimate of private rates of return to education.

Size of high school class (X_8) was included as a proxy for quality of high school. It was felt that both quantity and quality of courses offered would vary directly with the size of the high school. The negative coefficient was unexpected. The residence variable, however, may have served the purpose for which size of high school class was intended. Consequently, the size of high school class may have represented simply adverse motivational effects of anonymity.

Trend for Gaston Tech graduates (X_9) and trend for high school graduates (X_{10}) were measured as months from the date at which the Gaston Tech member of each pair graduated from the technical school. The use of two trend variables in the regression model allows the estimated effects of education to change over time. A recent analysis by Miller indicates that the income advantage resulting from education may grow until retirement.[1] The opposite conclusion had been reached by Miller in an earlier study.[2] His recent results suggest that the income advantage of education may be closely related to years of experience following schooling. The two trend variables in the regression equation provide an estimate of divergence in the monthly earnings of the two groups. The regression coefficient for education and the difference between the two trend coefficients provide an estimate of the postgraduate

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[1]H. P. Miller, "Lifetime Income and Economic Growth," American Economic Review, Vol. 55, 1965, pp. 834-843.

[2]H. P. Miller, Income of the American People, J. W. Wiley and Sons, New York, 1955.

returns on investment in technical schooling in any month. The estimated income advantage for Gaston Tech graduates in a particular month can be written as

$$Y_t = b_1 + (b_9 - b_{10})t$$

where b_1 is the coefficient for technical schooling (38.98), b_9 the trend coefficient for incomes of Gaston Tech graduates (3.42), b_{10} the trend coefficient for incomes of high school graduates (2.30), and t is the number of months since the Gaston Tech graduates completed their technical schooling.

APPENDIX B

Incomes were more variable among high school graduates than Gaston Tech graduates. However, there was no distinct trend in the standard deviation of high school incomes over the four-year period whereas the standard deviation of Gaston Tech incomes continued to increase directly with the length of time since graduation (Appendix B Table 1). The upward trend in the standard deviation of Gaston Tech incomes was relatively larger than the increase in earnings. Consequently, the coefficient of variation increased over the four-year period. In contrast, the combination of increasing high school incomes with rather stable variation resulted in a decline of the coefficient of variation.

The standard deviation of high school earnings may have been rather stable at such a high level because the income effects of differences in ability and on-the-job training of high school graduates could have approached a maximum very early in the post-high school period. Since Gaston Tech graduates were graduated from the same school and had two years less postgraduate work experience, income variations resulting from differences in ability and investments in on-the-job training may not reach a maximum for several years. Gaston Tech graduates probably receive more on-the-job training than high school graduates.[1] Consequently, a longer period of postgraduate work experience may be required for on-the-job training to have maximum effect on the variability of earnings for Gaston Tech graduates. Whether the variability of earnings by Gaston Tech graduates will eventually be as large or larger than for high school graduates cannot be determined without a longer data period.

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[1] J. Mincer, "On-The-Job Training: Costs, Returns and Some Implications," Journal of Political Economy, Vol. 70, (Supplement) 1962, pp. 50-79.

Appendix B Table 1. Variability in average monthly incomes of Gaston Technical Institute and high school graduates for specified months after completion of technical schooling

Month	Education	Average	Standard deviation	Standard error	Coefficient of variation
		(dollars)	(dollars)	(dollars)	(percent)
2	Gaston Tech	353	42.5	6.7	12.0
	High school	315	104.3	16.7	33.1
14	Gaston Tech	404	49.8	7.6	12.3
	High school	331	99.1	15.3	29.9
26	Gaston Tech	442	64.1	9.9	14.5
	High school	351	102.4	15.6	29.2
38	Gaston Tech	483	71.7	11.1	14.8
	High school	370	106.9	15.9	28.9
50	Gaston Tech	516	87.6	13.7	17.0
	High school	405	103.5	15.6	25.6